Deposit Interest Rate Ceilings as Credit Supply Shifters: Bank Level Evidence on the Effects of Regulation Q

Christoffer Koch
Federal Reserve Bank of Dallas

Atlanta Fed and Emory University Workshop on Monetary and Economic History

May 14, 2015

The views expressed in this presentation are those of the author and are not necessarily reflective of views at the Federal Reserve Bank of Dallas or the Federal Reserve System. Any errors or omissions are the sole responsibility of the author.
Abstract

Shocks emanating from and propagating through the banking system have recently gained interest in the macroeconomics literature, yet they are not a feature unique to the 2008/09 financial crisis. Banking disintermediation shocks occurred frequently during the Great Inflation era due to fixed deposit rate ceilings. I estimate the effect of deposit rate ceilings inscribed in Regulation Q on the transmission of federal funds rate changes to bank level credit growth using a historic bank level data set spanning half a century from 1959 to 2013 with about two million observations. Measures of the degree of bindingness of Regulation Q suggest that individual banks’ lending growth was smaller the more binding the legally fixed rate ceiling. Interaction terms with monetary policy suggest that the policy impact on bank level credit growth was non-linear at the ceiling “kink” and significantly larger when rate ceilings were in place. At the bank level, short-term interest rates exceeding the legally fixed deposit rate ceilings identify bank loan supply shifts that disappeared with deposit rate deregulation and thus weakened the credit channel of monetary transmission since the early 1980s.

Keywords: Monetary Transmission, Lending Channel, Regulation Q, Deregulation, Great Moderation, Shadow Banking

JEL Classification: E51, E52, E58, G18, G21
1 Deposit Deregulation and the Lending Channel
   - Motivation
   - Relation to the Literature
   - Empirical Work in Practice
   - Contribution(s)

2 Data, Specification, and Results

3 Conclusion
"All the legislative proposals need to be judged first of all against the central objective: We need to strengthen our ability to implement monetary policy in a variety of possible circumstances ..."

– Paul Volcker (1979)

Statement to Committee on Banking, Housing and Urban Affairs, U.S. Senate.

⇒ examine the consequences of the Depository Institutions Deregulation and Monetary Control Act of 1980 (DIDMCA) on monetary transmission through credit using bank level data

"All the legislative proposals need to be judged first of all against the central objective: We need to strengthen our ability to implement monetary policy in a variety of possible circumstances ..."

– Paul Volcker (1979)
Statement to Committee on Banking, Housing and Urban Affairs, U.S. Senate.
“All the legislative proposals need to be judged first of all against the central objective: We need to strengthen our ability to implement monetary policy in a variety of possible circumstances ...”

– Paul Volcker (1979)  
Statement to Committee on Banking, Housing and Urban Affairs, U.S. Senate.
“All the legislative proposals need to be judged first of all against the central objective: We need to strengthen our ability to implement monetary policy in a variety of possible circumstances ...”

– Paul Volcker (1979)
Statement to Committee on Banking, Housing and Urban Affairs, U.S. Senate.

=> examine the consequences of the Depository Institutions Deregulation and Monetary Control Act of 1980 (DIDMCA) on monetary transmission
“All the legislative proposals need to be judged first of all against the central objective: We need to strengthen our ability to implement monetary policy in a variety of possible circumstances ...”

– Paul Volcker (1979)

Statement to Committee on Banking, Housing and Urban Affairs, U.S. Senate.

⇒ examine the consequences of the Depository Institutions Deregulation and Monetary Control Act of 1980 (DIDMCA) on monetary transmission through credit
“All the legislative proposals need to be judged first of all against the central objective: We need to strengthen our ability to implement monetary policy in a variety of possible circumstances ...”

– Paul Volcker (1979)
Statement to Committee on Banking, Housing and Urban Affairs, U.S. Senate.

⇒ examine the consequences of the Depository Institutions Deregulation and Monetary Control Act of 1980 (DIDMCA) on monetary transmission through credit using bank level data
"The Great Moderation" (Bernanke, 2004)

Figure: Four Quarter Percentage Change in Nominal GDP
Sources of the Great Moderation

Stock & Watson (2002) put forward three nonexclusive explanations for “the long and large decline in US output volatility” (Blanchard & Simon, 2001)

1. “Good Policy”
   - Bernanke and Mihov (1998) and Sims and Zha (2006) ⇒ little evidence for a break in conduct of monetary policy

2. “Structural Change”
   - innovations in financial market that facilitate intertemporal smoothing of consumption and investment (Blanchard & Simon, 2001),
   - better inventory management through information technology
   - marked shift in output from goods to services (Burns, 1960, Moore & Zarnowitz, 1987)

3. “Good Luck”
   - reduction in structural shocks
Channels of Monetary Transmission

Open Market Operation

Reserves

Expected path of FFR
Expected path of Fed asset holdings

Expected path of short-term nominal interest rates

Loan supply
Asset price levels
Long-term real interest rates
Exchange rate
Relative asset prices

Aggregate demand

Policy communication and commitment
Expectations of inflation
Exchange rate channel
Portfolio balance effect
Expectations of inflation and exchange rates

Bank lending channel
Balance sheets channel
Wealth channel
Interest rate channel

Review: Channels of Monetary Transmission
### Stylized Commercial Bank Balance Sheet

Balance sheet of bank $i$ in quarter $t$

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserves</td>
<td>Equity</td>
</tr>
<tr>
<td>Securities</td>
<td>Debt</td>
</tr>
<tr>
<td>Loans ($L_{i,t}$)</td>
<td>Deposits</td>
</tr>
<tr>
<td>· C&amp;I Loans</td>
<td>· Demand Deposits</td>
</tr>
<tr>
<td>· Individual Loans</td>
<td>· Time Deposits</td>
</tr>
<tr>
<td>· Mortgages</td>
<td>· ...</td>
</tr>
</tbody>
</table>

Denote any set of bank characteristics of bank $i$ at quarter $t$ as $B_{i,t}$. 
Balance Sheet Items Co-Movements

Note: Shaded area indicates NBER recession.
Sources: FFIEC Call Reports; author's own calculations.

Figure: Changing Co-Movement Due to Financial Liberalization

Balance Sheet Items Co-Movements

Note: Shaded area indicates NBER recession. 
Sources: FFIEC Call Reports; author's own calculations.
Balance Sheet Items Co-Movements

![Chart showing co-movements of balance sheet items over time with shaded areas indicating NBER recessions. Sources: FFIEC Call Reports; author's own calculations.](image-url)

Note: Shaded area indicates NBER recession.
Sources: FFIEC Call Reports; author's own calculations.
Balance Sheet Items Co-Movements

Figure: Changing Co-Movement Due to Financial Liberalization

Note: Shaded area indicates NBER recession. Sources: Federal Reserve Board; author’s own calculations.
Banking Act of 1933

Regulation Q of the Federal Reserve

... prohibited interest payments on demand deposits
... imposed interest rate ceilings on time and savings deposits

at commercial banks.

Purpose at the time

- shelter banks from excessive competition
- discourage risky investment
- prevent future bank failures

⇒ most of the ceilings phased out between 1980 and 1986 through the Depository Institutions Deregulation and Monetary Control Act of 1980 (DIDMCA)
Deposit Rate Ceilings and Short-Term Interest Rates

Figure: Fixed Deposit Rate Ceilings and Short-Term Rates
“By the third quarter of 1966, nonfinancial firms were cut off from the commercial loan market. It was largely monetary policy that kept banks from extending further credit to the corporate sector. Specifically, the Federal Reserve tightened monetary policy at the end of 1965 and increased the discount rate from four percent to 4.5 percent. In response, banks increasingly relied on time deposits as a source of funds because they had a lower reserve requirement than demand deposits. This allowed the commercial banks to accommodate loan demand. However, in June, the Federal Reserve increased the reserve requirement on time deposits making it more expensive for banks to raise funds through the time deposit market. Perhaps part of the motivation for the Federal Reserve was that the President had indicated he was counting on the Federal Reserve to keep credit in check to avoid inflation. At the same time, the Federal Reserve refused to raise the regulation Q ceiling on large time deposits and, in the summer, the market interest rate rose above the regulated rate for both long- and short-term certificates of deposit (CDs). These policies of the Federal Reserve made it difficult for banks to continue to lend which is why the corporate sector was shut out of the credit market towards the end of 1966. (...) [T]he credit crunch of 1966 exposed weaknesses in the regulatory regime; specifically in the constraints caused by binding price ceilings.”

(Hendrickson, 2011, p. 177)
“In non-VAR models, not properly accounting for Reg Q upwardly biases the estimated real rate elasticity of U.S. GDP and yields rate elasticities that are not stable enough for practical use. (...) [A]ccurately measured Reg Q innovations are significant in VARs and (...) have impulse response functions that do no change much as samples are extended beyond the early 1980s.”

→ Estimate effect of Regulation Q on bank level credit growth

Why might this be a good idea?
Figure: Bernanke and Blinder (1992) VAR Impulse Responses
When was Regulation Q binding?

Note: The vertical gray bars denote NBER recession dates. *) evidence based on aggregate data **) evidence based on bank-level data. Source: Duca (1996)

Although there is not a consensus about the size of the coefficients of policy rules, it is useful to consider what a representative policy rule might look like. One policy rule that captures the spirit of the recent research and which is quite straightforward is:

\[ r = p + .5y + .5(p - 2) + 2 \]  \hspace{1cm} (1)

where

\[ \begin{align*}
   r & \text{ is the federal funds rate,} \\
   p & \text{ is the rate of inflation over the previous four quarters} \\
   y & \text{ is the percent deviation of real GDP from a target.}
\end{align*} \]

That is,

\[ y = 100(Y - Y^*)/Y^* \]  \hspace{1cm} \text{where}

\[ \begin{align*}
   Y & \text{ is real GDP, and} \\
   Y^* & \text{ is trend real GDP (equals 2.2 percent per year from 1984.1 through 1992.3).}
\end{align*} \]
The Taylor Principle and the Great Moderation

Timing of anchoring of inflation expectations

- FRB Dallas -

Michigan Survey (Avg): 5-10 Years
SPF: 5-10 Years
Cúrdia & Woodford (2010)
– Different Marginal Utilities of Consumption

Fig. 1. Marginal Utilities of Consumption for Households of the Two Types.
Note: The values $\bar{c}^s$ and $\bar{c}^b$ indicate steady-state consumption levels of the two types, and $\bar{c}^s$ and $\bar{c}^b$ their corresponding steady-state marginal utilities.

Intermediation requires real resources. In order to provide \( b \) of loans require total real outlays of

\[
\begin{align*}
    b_t + \chi_t b_t + \Xi_t(b_t),
\end{align*}
\]

\[\Rightarrow \text{ assume } \Xi(b) = \tilde{\Xi} b^n \text{ for intermediation technology with } \theta \approx 5\]

Competitive loan supply

\[
1 + i_t^b = (1 + i_t^d)(1 + \omega_t)
\]

Equilibrium credit spread

\[
\omega_t = \omega_t(b_t) = \chi_t + \Xi_t'(b_t)
\]

Monetary policy

\[
i_t^d = i_t^d(\Pi_t, Y_t)
\]

Spread-adjusted Taylor rule

\[ \hat{i}_t^d = r_t^n + \phi_\pi \pi_t + \phi_y \log \left( \frac{Y_t}{Y_t^n} \right) - \phi_\omega \hat{\omega}_t \]

- \( \phi_\pi = 1.5 \), \( \phi_y = 0.5/4 \)
- output gap relative to natural flexible-price equilibrium (distortions at steady state values)
- \( r_t^n \) – natural rate of interest

Alternatively, credit-adjusted Taylor rule

\[ \hat{i}_t^d = r_t^n + \phi_\pi \pi_t + \phi_y \log \left( \frac{Y_t}{Y_t^n} \right) - \phi_b \hat{b}_t \]
## Cúrdia & Woodford (2010) – Welfare Trade-Offs

### TABLE 4

**Welfare Consequences of Increasing \( \phi_w \), in the Case of Different Disturbances**

<table>
<thead>
<tr>
<th>( \varphi \times 10^5 )</th>
<th>( x_t )</th>
<th>( \hat{z}_t )</th>
<th>( \hat{C}_t^b )</th>
<th>( \hat{C}_t^s )</th>
<th>( G_t )</th>
<th>( b_t^g )</th>
<th>( Z_t, \bar{H}_t )</th>
<th>( \mu_t^w )</th>
<th>( \tau_t )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline persistence (( \rho_s = 0.90 ))</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \phi_w = 0.25 )</td>
<td>27.59</td>
<td>27.59</td>
<td>-1.07</td>
<td>-2.94</td>
<td>-0.37</td>
<td>28.17</td>
<td>-0.07</td>
<td>9.43</td>
<td>9.32</td>
</tr>
<tr>
<td>( \phi_w = 0.50 )</td>
<td>42.52</td>
<td>41.72</td>
<td>-3.20</td>
<td>-8.88</td>
<td>-1.22</td>
<td>42.54</td>
<td>-0.22</td>
<td>18.77</td>
<td>18.57</td>
</tr>
<tr>
<td>( \phi_w = 0.75 )</td>
<td>44.20</td>
<td>41.77</td>
<td>-6.42</td>
<td>-17.89</td>
<td>-2.57</td>
<td>42.47</td>
<td>-0.45</td>
<td>28.04</td>
<td>27.74</td>
</tr>
<tr>
<td>( \phi_w = 1.00 )</td>
<td>32.03</td>
<td>27.10</td>
<td>-10.75</td>
<td>-30.02</td>
<td>-4.42</td>
<td>27.31</td>
<td>-0.76</td>
<td>37.23</td>
<td>36.83</td>
</tr>
<tr>
<td><strong>High persistence (( \rho_s = 0.99 ))</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \phi_w = 0.25 )</td>
<td>0.25</td>
<td>4.16</td>
<td>-3.92</td>
<td>-9.58</td>
<td>-2.15</td>
<td>2.73</td>
<td>-0.45</td>
<td>7.71</td>
<td>7.70</td>
</tr>
<tr>
<td>( \phi_w = 0.50 )</td>
<td>-15.89</td>
<td>-10.15</td>
<td>-8.47</td>
<td>-20.67</td>
<td>-4.64</td>
<td>-13.12</td>
<td>-0.97</td>
<td>15.37</td>
<td>15.35</td>
</tr>
<tr>
<td>( \phi_w = 0.75 )</td>
<td>-49.05</td>
<td>-43.64</td>
<td>-13.65</td>
<td>-33.33</td>
<td>-7.48</td>
<td>-48.25</td>
<td>-1.55</td>
<td>22.96</td>
<td>22.93</td>
</tr>
<tr>
<td>( \phi_w = 1.00 )</td>
<td>-99.88</td>
<td>-97.03</td>
<td>-19.46</td>
<td>-47.52</td>
<td>-10.66</td>
<td>-103.40</td>
<td>-2.22</td>
<td>30.49</td>
<td>30.45</td>
</tr>
</tbody>
</table>

**Notes:** Each column indicates a different type of disturbance, while each row corresponds to a given degree of spread adjustment. A value of 1 means a welfare increase equivalent to a permanent 0.001% increase in consumption by households of both types.
Modigliani-Miller (1958)

- **Modigliani-Miller (1958)**
  With frictionless financial markets, firms’ capital structure is indeterminate, and the aggregate mix of debt versus equity is irrelevant for the evolution of the real economy.

- In the light of the M-M result, until 2008 business cycle theory had largely abstracted from incorporating financial factors into models of aggregate fluctuations:
  - IS-LM framework
  - Real business cycle models
  - New Keynesian synthesis
Bernanke and Gertler (1989)

Reflecting informational asymmetries between borrowers and lenders, borrowers’ balance sheets can play an important role in the propagation of economic shocks - the financial accelerator

Financial accelerator:
- Informational frictions in credit markets induce a wedge between the cost of external and internal funds - the external finance premium (EFP)
- Size of the EFP depends inversely on the borrower’s net worth
- Declines in equity valuation and/or unexpected deflation reduce borrower’s net worth
- Procyclical net worth leads to countercyclical EFP, enhancing swings in borrowing, investment, and output
Financial Frictions – Theory

- **Fisher (1933), Bernanke (2004)**
  Role of “debt-deflation” during the Great Depression

  Microeconomic implications of informational asymmetries in goods and financial markets

- Banking theory literature from Diamond & Dybvig (1983) to Dang, Gorton, Holmström, & Ordoñez (2014) and Hanson, Shleifer, Stein, & Vishny (2014)

- DSGE models, see BGG (1999) and various follow ups

Financial Frictions – Bank Level Evidence

- **Kashyap and Stein (2000)** – Banks with large and liquid asset bases better able to smooth lending during periods of tight policy
- **Kishan and Opiela (2000)** – High equity capital to assets
- **Loutskina (2005)**
  - Banks whose loan books readily securitized
- **Ashcraft (2006)** – Banks affiliated with a holding company
- **Jonas and King (2008)**
  - Banks close to the efficiency frontier
- **Cetorelli and Goldberg (2013)**
  - Banks with international exposure
  - Loan level data and bank balance sheets
Balance sheet of bank $i$ in quarter $t$

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserves</td>
<td>Equity</td>
</tr>
<tr>
<td>Securities</td>
<td>Debt</td>
</tr>
<tr>
<td>Loans ($L_{i,t}$)</td>
<td>Deposits</td>
</tr>
<tr>
<td>· C&amp;I Loans</td>
<td>· Demand Deposits</td>
</tr>
<tr>
<td>· Individual Loans</td>
<td>· Time Deposits</td>
</tr>
<tr>
<td>· Mortgages</td>
<td>·</td>
</tr>
</tbody>
</table>

Denote any set of bank characteristics of bank $i$ at quarter $t$ as $B_{i,t}$. 
Typical estimates of bank lending responses to monetary policy:

\[ \Delta L_{i,t} = \alpha + \beta M_t + \gamma' B_{i,t-1} + \delta' B_{i,t-1} M_t + \text{other controls} + \varepsilon_{i,t} \]

- \( \Delta L_{i,t} \) growth of total loans measured at current prices,
- \( M_t \) monetary policy,
- \( B_{i,t} \) set of bank characteristics,
- \( \varepsilon_{i,t} \) error term,

and \( i \) denotes bank entity and \( t \) indexes time.
Heterogeneity in Lending Growth

Four Quarter Bank Level Credit Growth

-20 -10 0 10 20 30 40 50
Heterogeneity in Lending Growth

Four Quarter Bank Level Credit Growth

![Graph showing four quarter bank level credit growth from 1960 to 2010.](image)
Heterogeneity in Lending Growth

Four Quarter Bank Level Credit Growth
Issues in Bank Level Evidence and Contributions

Issues in bank level evidence

- Heterogeneity in specific characteristic interpreted as pure loan supply effect
- However, amalgam of possible loan supply and loan demand effects depending on customer mix, risk taking behaviour etc.
- Little/no attention to important regulatory changes

Contributions

1. Extension up to recently available data, 2013 Q4, extension back to 1959 Q4 ⇒ 50+ years of quarterly data
2. Controlling for bank level heterogeneity in credit growth cyclicality with respect to non-policy factors
3. Estimation of loan supply effect of regulatory change in the DIDMCA 1980, that is, the abolition of Regulation Q
Deposit Deregulation and the Lending Channel

Data, Specification, and Results
- Microeconomic Data
- Macroeconomic Data
- Specification
- Estimation Results

Conclusion
Microeconomic Data – Bank Level Data

- Reports of Condition and Income (RCRI) submitted to the FDIC ("call reports")
- Quarterly bank balance sheet data from 1959 Q4 to 2013 Q4
- Excluding mergers (merged banks enter as new ones)
- About two million observations
- Outliers exclusion using absolute DFITS statistic (see Welsch and Kuh, 1977)
Microeconomic Data – Bank Level Data

Obtaining consistent entity-level time-series following Kashyap and Stein (2000) and by reading the original report forms:

- **Loans**
  “Total Loans minus Allowances for Loan Losses”

- **Assets**
  “Total Assets”

- **Cash**
  “Cash & Due”

- **Securities**
  “Total Investment Securities”, “Assets Held in Trading Accounts”

- **Capitalization**
  book value of “Equity Issued plus Cumulated Value of Retained Earnings”
Microeconomic Data – Bank Level Data

- four bank level controls
  1. bank size
  1. capitalization
  3. cash
  4. securities

⇒ controls limited by consistent availability throughout sample
- demeaned by
  1. quarterly mean (ratios)
  2. quarterly median (size)
- normalized by
  1. quarterly standard deviation (ratios)
  2. quarterly percentile (size)
## Microeconomic Data – Bank Level Data

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Assets (1000s)</td>
<td>18,257</td>
<td>40,379</td>
<td>115,350</td>
<td>199,898</td>
<td>392,525</td>
<td>1,026,274</td>
</tr>
<tr>
<td></td>
<td>(181,465)</td>
<td>(477,448)</td>
<td>(1,683,451)</td>
<td>(2,020,080)</td>
<td>(5,280,087)</td>
<td>(16,897,724)</td>
</tr>
<tr>
<td>Loans ratio</td>
<td>40.4</td>
<td>47.9</td>
<td>53.5</td>
<td>53.8</td>
<td>61.6</td>
<td>62.4</td>
</tr>
<tr>
<td></td>
<td>(11.3)</td>
<td>(11.2)</td>
<td>(11.6)</td>
<td>(15.8)</td>
<td>(15.8)</td>
<td>(15.8)</td>
</tr>
<tr>
<td>Deposits ratio</td>
<td>89.3</td>
<td>88.6</td>
<td>88.0</td>
<td>87.8</td>
<td>82.7</td>
<td>83.9</td>
</tr>
<tr>
<td></td>
<td>(3.4)</td>
<td>(4.4)</td>
<td>(5.3)</td>
<td>(9.1)</td>
<td>(11.5)</td>
<td>(8.8)</td>
</tr>
<tr>
<td>Capital ratio</td>
<td>9.3</td>
<td>8.6</td>
<td>9.0</td>
<td>9.3</td>
<td>11.4</td>
<td>10.9</td>
</tr>
<tr>
<td></td>
<td>(3.2)</td>
<td>(4.1)</td>
<td>(4.1)</td>
<td>(6.0)</td>
<td>(8.2)</td>
<td>(6.0)</td>
</tr>
<tr>
<td>Cash ratio</td>
<td>17.8</td>
<td>12.4</td>
<td>9.5</td>
<td>7.4</td>
<td>5.1</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>(7.0)</td>
<td>(5.8)</td>
<td>(5.7)</td>
<td>(5.8)</td>
<td>(5.3)</td>
<td>(9.2)</td>
</tr>
<tr>
<td>Securities ratio</td>
<td>39.1</td>
<td>34.3</td>
<td>28.5</td>
<td>29.0</td>
<td>25.0</td>
<td>21.4</td>
</tr>
<tr>
<td></td>
<td>(11.3)</td>
<td>(11.9)</td>
<td>(11.4)</td>
<td>(15.6)</td>
<td>(14.2)</td>
<td>(15.3)</td>
</tr>
<tr>
<td>Multi-bank holding company</td>
<td>2.4</td>
<td>7.0</td>
<td>15.9</td>
<td>29.6</td>
<td>25.4</td>
<td>15.7</td>
</tr>
<tr>
<td>One-bank holding company</td>
<td>0.0</td>
<td>8.9</td>
<td>17.8</td>
<td>39.8</td>
<td>52.5</td>
<td>66.5</td>
</tr>
<tr>
<td>Stand alone</td>
<td>97.6</td>
<td>84.1</td>
<td>66.3</td>
<td>30.6</td>
<td>22.1</td>
<td>17.8</td>
</tr>
<tr>
<td>No of Observations</td>
<td>12,958</td>
<td>13,317</td>
<td>14,199</td>
<td>11,450</td>
<td>7,859</td>
<td>6,197</td>
</tr>
</tbody>
</table>

**Table:** Bank Characteristics, 1960 – 2010
Microeconomic Data – Interpolation and Time-Shifts
Microeconomic Data – Interpolation and Time-Shifts

Microeconomic Data – Interpolation and Time-Shifts
Microeconomic Data – Interpolation and Time-Shifts
Microeconomic Data – Interpolation and Time-Shifts
Microeconomic Data – Interpolation and Time-Shifts
Microeconomic Data – Interpolation and Time-Shifts
Microeconomic Data – Interpolation and Time-Shifts
Further assumptions due to incomplete data and irregular timing:

(a) Interpolation

(b) Irregular Timing
Macroeconomic Data – Description

- **Real Income Growth**
  Seasonally adjusted chained-prices GDP (BEA)

- **Inflation Rate**
  Core Personal Consumption Expenditure Deflator (BEA)

- **Monetary Policy**
  Changes in the final day of quarter differences in the federal funds rate to mirror balance sheet availability

- **Regulatory Control**
  Difference between short-term Treasury yield and rate ceilings, adjusting for financial innovation, the introduction of small-saver certificates (SSC) as a substitute for deposits
  ⇒ see chart in motivation section
Figure: Four Quarter Change in Real GDP
Macroeconomic Data – Change in PCE Index

Figure: Four Quarter Change in PCE Index (ex food and energy)
Figure: End-of-Quarter Change in the Federal Funds Rate
Regression Specification – Baseline

\[ \Delta L_{i,t} = \alpha + \sum_{\ell=1}^{4} \rho_{\ell} \cdot \Delta L_{i,t-\ell} + \sum_{j=1}^{3} \sum_{\ell=0}^{4} \beta_{j,\ell} \cdot M_{j,t-\ell} \]

\[ + \sum_{k=0}^{3} \sum_{j=1}^{3} \gamma_{k,j,\ell} \cdot B_{i,k,t-1} \cdot M_{j,t-\ell} \]

\[ + \text{ other controls} + \varepsilon_{i,t} \]

- **M_t** contains
  - Quarter-end-to-quarter-end change in the federal funds rate (mirror image of “snapshot” balance sheets)
  - Four quarter growth of real GDP
  - Four quarter growth of the core PCE deflator

- **B_i** contains bank characteristics, note:
  - Timing of characteristics \( t - 1 \)
  - Characteristics such that they are normalized for interpretation
  - Real income growth, inflation and policy interaction with the characteristics

- Seasonals, trend, Great Moderation dummy and policy interaction
Regression Specification – Details

\[ \Delta L_{i,t} = \alpha + \sum_{\ell=1}^{4} \rho_{\ell} \cdot \Delta L_{i,t-\ell} + \sum_{j=1}^{3} \sum_{\ell=0}^{4} \beta_{j,\ell} \cdot M_{j,t-\ell} + \sum_{k=1}^{3} \delta_{k} \cdot B_{i,k,t-1} + \sum_{k=0}^{3} \sum_{j=1}^{4} \sum_{\ell=0}^{4} \gamma_{k,j,\ell} \cdot B_{i,k,t-1} \cdot M_{j,t-\ell} + \text{other controls} + \varepsilon_{i,t} \]  

Previous literature unnecessarily restrictive by setting:

\[ \sum_{\ell=0}^{4} \gamma_{k,j,\ell} = 0 \quad \text{with} \quad j = 1, 2 \quad k = 1, 2, 3, 4 \]  

(Homogenous Loan Demand)

where \( \ell \) again denotes lags. In this specification allow for

\[ \sum_{\ell=0}^{4} \gamma_{k,j,\ell} \neq 0 \quad \text{with} \quad j = 1, 2 \quad k = 1, 2, 3, 4 \]  

(Heterogeneous Loan Demand)
Interested in policy response of lending growth, but note - amalgam of loan supply and demand:

\[ H_0 : \sum_{\ell=0}^{4} \beta_{3,\ell} = 0 \]  
(Policy Response)

Variations across proxies for bank level financial constraints in order to identify loan supply shifters:

\[ H_0 : \sum_{\ell=0}^{4} \gamma_{k,3,\ell} = 0 \quad \text{with} \quad k = 1, 2, 3, 4 \]  
(Bank Level Loan Supply Shifts)
Regression Specification – Deposit Rate Ceilings

\[ \begin{align*}
(1) & \quad + \sum_{\ell=0}^{4} \varrho_{\text{level}}^\ell \cdot \text{Reg}_t^{t-\ell} + \sum_{k=0}^{3} \sum_{\ell=0}^{4} \varrho_{\text{inter}}^k_{i,\ell} \cdot B_{i,k,t-1} \cdot \text{Reg}_t^{t-\ell} \\
(2) & \quad + \sum_{\ell=0}^{4} \varrho_{\text{pol level}}^\ell \cdot \text{Reg}_t^{t-\ell} + \sum_{k=0}^{3} \sum_{\ell=0}^{4} \varrho_{\text{pol inter}}^k_{i,\ell} \cdot B_{i,k,t-1} \cdot \text{Reg}_t^{t-\ell}
\end{align*} \]
Regression Specification – Deposit Rate Ceilings

\[ (1) + \sum_{\ell=0}^{4} \varrho_{\ell}^{level} \cdot \text{Reg}Q_{t-\ell} + \sum_{k=0}^{3} \sum_{\ell=0}^{4} \varrho_{k,\ell}^{inter} \cdot B_{i,k,t-1} \cdot \text{Reg}Q_{t-\ell} \]

\[ (2) + \sum_{\ell=0}^{4} \varrho_{\ell}^{pol level} \cdot \text{Reg}Q_{t-\ell} \cdot \Delta ff_{t-\ell} \]

\[ (3) + \sum_{k=1}^{3} \sum_{\ell=0}^{4} \varrho_{k,\ell}^{pol inter} \cdot B_{i,k,t-1} \cdot \text{Reg}Q_{t-\ell} \cdot \Delta ff_{t-\ell} \]
Regression Specification – Deposit Rate Ceilings

(1) \[ + \sum_{\ell=0}^{4} \varphi_{\text{level}}^{\ell} \cdot \text{RegQ}_{t-\ell} + \sum_{k=0}^{3} \sum_{\ell=0}^{4} \varphi_{\text{inter}}^{k,\ell} \cdot B_{i,k,t-1} \cdot \text{RegQ}_{t-\ell} \]

(2) \[ + \sum_{k=1}^{4} \sum_{\ell=0}^{4} \varphi_{\text{pol level}}^{k,\ell} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]

(3) \[ + \sum_{k=1}^{4} \sum_{\ell=0}^{4} \varphi_{\text{pol inter}}^{k,\ell} \cdot B_{i,k,t-1} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]

(4) \[ + \sum_{k=1}^{4} \sum_{\ell=0}^{4} \varphi_{\text{pol level}}^{k,\ell} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]
Regression Specification – Reg Q as Loan Supply Shifter

(1) \[
\sum_{\ell=0}^{4} \rho_{\ell}^{level} \cdot \text{Reg}Q_t - \ell + \sum_{k=1}^{3} \sum_{\ell=0}^{4} \rho_{\ell}^{inter} \cdot B_{i,k,t-1} \cdot \text{Reg}Q_t - \ell \\
+ \sum_{\ell=0}^{4} \rho_{\ell}^{pol level} \cdot \text{Reg}Q_t - \ell \cdot \Delta ff_t - \ell \\
+ \sum_{k=1}^{3} \sum_{\ell=0}^{4} \rho_{\ell}^{pol inter} \cdot B_{i,k,t-1} \cdot \text{Reg}Q_t - \ell \cdot \Delta ff_t - \ell
\]

Note how the bindingness of Regulation Q is a pure supply shifter - does not directly influence loan demand at the bank level!

\[H_0 : \sum_{\ell=0}^{4} \rho_{\ell}^{level} = 0\]  
(Regulation Q Credit Supply Shifter)

\[H_0 : \sum_{\ell=0}^{4} \rho_{\ell}^{inter} = 0 \quad \text{with} \quad k = 1, 2, 3, 4\]  
(Heterogeneity in Regulatory Impact)
Results – Overview

\[ \Delta L_{i,t} = \alpha + \sum_{\ell=1}^{4} \rho_{\ell} \cdot \Delta L_{i,t-\ell} + \sum_{j=1}^{4} \sum_{\ell=0}^{4} \beta_{j,\ell} \cdot M_{j,t-\ell} \]

\[ + \sum_{k=1}^{3} \delta_{k} \cdot B_{i,k,t-1} + \sum_{k=0}^{3} \sum_{j=1}^{4} \gamma_{k,j,\ell} \cdot B_{i,k,t-1} \cdot M_{j,t-\ell} \]

\[ + \text{other controls} + \varepsilon_{i,t} \]

\[ (1) + \sum_{\ell=0}^{4} \varrho_{\ell}^{\text{level}} \cdot \text{RegQ}_{t-\ell} + \sum_{k=0}^{3} \sum_{\ell=0}^{4} \varrho_{k,\ell}^{\text{inter}} \cdot B_{i,k,t-1} \cdot \text{RegQ}_{t-\ell} \]

\[ (1) + \sum_{\ell=0}^{4} \varrho_{\ell}^{\text{pol level}} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]

\[ + \sum_{k=1}^{3} \sum_{\ell=0}^{4} \varrho_{k,\ell}^{\text{pol inter}} \cdot B_{i,k,t-1} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]

\[ (1) + \sum_{\ell=0}^{4} \varrho_{\ell}^{\text{level}} \cdot \text{RegQ}_{t-\ell} + \sum_{k=1}^{3} \sum_{\ell=0}^{4} \varrho_{k,\ell}^{\text{inter}} \cdot B_{i,k,t-1} \cdot \text{RegQ}_{t-\ell} \]

\[ + \sum_{\ell=0}^{4} \varrho_{\ell}^{\text{pol level}} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]

\[ + \sum_{k=1}^{3} \sum_{\ell=0}^{4} \varrho_{k,\ell}^{\text{pol inter}} \cdot B_{i,k,t-1} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]

\[ \Delta y_{t} = \alpha + \sum_{\ell=1}^{4} \varrho_{\ell} \cdot \Delta y_{t,\ell} + \sum_{k=1}^{4} \sum_{j=1}^{4} \gamma_{k,j,\ell} \cdot B_{i,k,t-1} \cdot M_{j,t-\ell} \]

\[ + \text{other controls} + \varepsilon_{t} \]

\[ (5) + \sum_{\ell=0}^{4} \varrho_{\ell}^{\text{level}} \cdot \text{RegQ}_{t-\ell} + \sum_{k=0}^{3} \sum_{\ell=0}^{4} \varrho_{k,\ell}^{\text{inter}} \cdot B_{i,k,t-1} \cdot \text{RegQ}_{t-\ell} \]

\[ (5) + \sum_{\ell=0}^{4} \varrho_{\ell}^{\text{pol level}} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]

\[ + \sum_{k=1}^{3} \sum_{\ell=0}^{4} \varrho_{k,\ell}^{\text{pol inter}} \cdot B_{i,k,t-1} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]

\[ (6) + \sum_{\ell=0}^{4} \varrho_{\ell}^{\text{level}} \cdot \text{RegQ}_{t-\ell} + \sum_{k=1}^{3} \sum_{\ell=0}^{4} \varrho_{k,\ell}^{\text{inter}} \cdot B_{i,k,t-1} \cdot \text{RegQ}_{t-\ell} \]

\[ + \sum_{\ell=0}^{4} \varrho_{\ell}^{\text{pol level}} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]

\[ + \sum_{k=1}^{3} \sum_{\ell=0}^{4} \varrho_{k,\ell}^{\text{pol inter}} \cdot B_{i,k,t-1} \cdot \text{RegQ}_{t-\ell} \cdot \Delta ff_{t-\ell} \]

Robust standard errors after clustering at bank level in parentheses.

\* \( p < 0.10 \), \** \( p < 0.05 \), \*** \( p < 0.01 \)
## Results – Overview

<table>
<thead>
<tr>
<th>$\Delta L_{i,t}$</th>
<th>Model:</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\sum_{t=0}^{4} \Delta ff_{t-\ell}$</td>
<td>-0.75***</td>
<td>-0.80***</td>
<td>0.25***</td>
<td>0.46***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>$\sum_{t=0}^{4} \text{RegQ}_{t-\ell}$</td>
<td></td>
<td>-0.15***</td>
<td></td>
<td>-0.27***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.02)</td>
<td></td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>$\sum_{t=0}^{4} \text{RegQ}<em>{t-\ell} \cdot \Delta ff</em>{t-\ell}$</td>
<td></td>
<td></td>
<td>-0.65***</td>
<td>-0.77***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>$\sum_{t=0}^{4} \Delta ff_{t-\ell} + \text{RegQ}<em>{t-\ell} \cdot \Delta ff</em>{t-\ell}$</td>
<td></td>
<td></td>
<td>-0.41***</td>
<td>-0.31***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td></td>
</tr>
</tbody>
</table>

| $R^2$ | 0.83 | 0.83 | 0.83 | 0.83 |
| Observations | 1,159,253 | 1,160,365 | 1,160,123 | 1,160,686 |

Robust standard errors after clustering at bank level in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
## Results – Overview

<table>
<thead>
<tr>
<th>$\Delta L_{i,t}$</th>
<th>Model:</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sum_{t=0}^4 \Delta y_{t-\ell}$</td>
<td>$\sum_{t=0}^4 \Delta p_{t-\ell}$</td>
<td>$\sum_{t=0}^4 \text{GMod}_{t-\ell}$</td>
<td>$\sum_{t=0}^4 \text{GMod}<em>{t-\ell} \cdot \Delta ff</em>{t-\ell}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.48*** (0.01)</td>
<td>0.30*** (0.01)</td>
<td>-2.64*** (0.05)</td>
<td>-1.84*** (0.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.45*** (0.01)</td>
<td>0.35*** (0.01)</td>
<td>-2.52*** (0.05)</td>
<td>-1.74*** (0.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.39*** (0.01)</td>
<td>0.18*** (0.01)</td>
<td>-3.44*** (0.05)</td>
<td>-2.71*** (0.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.37*** (0.01)</td>
<td>0.26*** (0.01)</td>
<td>-3.42*** (0.05)</td>
<td>-2.82*** (0.05)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Robust standard errors after clustering at bank level in parentheses.

$* p < 0.10$, $** p < 0.05$, $*** p < 0.01$
## Results – Bank Size

<table>
<thead>
<tr>
<th>( \Delta L_{i,t} )</th>
<th>Model:</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \sum_{t=0}^{4} \Delta ff_{t-\ell} )</td>
<td>-0.75***</td>
<td>-0.80***</td>
<td>0.25***</td>
<td>0.46***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.03)</td>
<td></td>
</tr>
<tr>
<td>( Assets_{i,t-1} )</td>
<td>-1.69***</td>
<td>-1.70***</td>
<td>-1.37***</td>
<td>-1.39***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.20)</td>
<td>(0.21)</td>
<td>(0.21)</td>
<td>(0.21)</td>
<td></td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} Assets_{i,t-1} \cdot \Delta ff_{t-\ell} )</td>
<td>0.44***</td>
<td>0.77***</td>
<td>-0.01</td>
<td>0.61***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.06)</td>
<td>(0.10)</td>
<td>(0.11)</td>
<td></td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} Assets_{i,t-1} \cdot \Delta y_{t-\ell} )</td>
<td>-0.06***</td>
<td>-0.04*</td>
<td>-0.05**</td>
<td>-0.04*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} Assets_{i,t-1} \cdot \Delta p_{t-\ell} )</td>
<td>-0.28***</td>
<td>-0.20***</td>
<td>-0.33***</td>
<td>-0.26***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} Assets_{i,t-1} \cdot RegQ_{t-\ell} )</td>
<td>-0.46***</td>
<td>-0.32***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.06)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} Assets_{i,t-1} \cdot RegQ_{t-\ell} \cdot \Delta ff_{t-\ell} )</td>
<td>0.40***</td>
<td>0.21***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.05)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} Assets_{i,t-1} \cdot \Delta ff_{t-\ell} + Assets_{i,t-1} \cdot RegQ_{t-\ell} \cdot \Delta ff_{t-\ell} )</td>
<td>0.39***</td>
<td>0.82***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.08)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| \( R^2 \) | 0.83 | 0.83 | 0.83 | 0.83 |
| Observations | 1,159,253 | 1,160,365 | 1,160,123 | 1,160,686 |

Robust standard errors after clustering at bank level in parentheses.

* \( p < 0.10 \), ** \( p < 0.05 \), *** \( p < 0.01 \)
## Results – Capitalization

<table>
<thead>
<tr>
<th>( \Delta L_{i,t} )</th>
<th>Model:</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \sum_{t=0}^{4} \Delta ff_{t-\ell} )</td>
<td></td>
<td>-0.75***</td>
<td>-0.80***</td>
<td>0.25***</td>
<td>0.46***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>( \text{Equity}_{i,t-1} )</td>
<td></td>
<td>-0.36***</td>
<td>-0.46***</td>
<td>-0.39***</td>
<td>-0.43***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.07)</td>
<td>(0.08)</td>
<td>(0.07)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} \text{Equity}<em>{i,t-1} \cdot \Delta ff</em>{t-\ell} )</td>
<td>0.08***</td>
<td>0.02</td>
<td>-0.13***</td>
<td>-0.31***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.03)</td>
<td>(0.03)</td>
<td>(0.05)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} \text{Equity}<em>{i,t-1} \cdot \Delta y</em>{t-\ell} )</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} \text{Equity}<em>{i,t-1} \cdot \Delta p</em>{t-\ell} )</td>
<td>0.02**</td>
<td>0.02*</td>
<td>0.02***</td>
<td>-0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} \text{Equity}<em>{i,t-1} \cdot \text{RegQ}</em>{t-\ell} )</td>
<td>0.12***</td>
<td>0.17***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.03)</td>
<td>(0.03)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} \text{Equity}<em>{i,t-1} \cdot \text{RegQ}</em>{t-\ell} \cdot \Delta ff_{t-\ell} )</td>
<td>0.12***</td>
<td>0.19***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.02)</td>
<td>(0.03)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \sum_{t=0}^{4} \text{Equity}<em>{i,t-1} \cdot \Delta ff</em>{t-\ell} + \text{Equity}<em>{i,t-1} \cdot \text{RegQ}</em>{t-\ell} \cdot \Delta ff_{t-\ell} )</td>
<td>-0.01</td>
<td>-0.12***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.03)</td>
<td>(0.04)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ R^2 \]
Observations

<table>
<thead>
<tr>
<th></th>
<th>(5)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.83</td>
<td>0.83</td>
<td>0.83</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>1,159,253</td>
<td>1,160,365</td>
<td>1,160,123</td>
<td>1,160,686</td>
</tr>
</tbody>
</table>

Robust standard errors after clustering at bank level in parentheses.

* \( p < 0.10 \), ** \( p < 0.05 \), *** \( p < 0.01 \)
## Results – Cash Holdings

<table>
<thead>
<tr>
<th>Model</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\Delta L_{i,t}$</td>
<td>$\sum_{t=0}^{4} \Delta ff_{t-\ell}$</td>
<td>$\sum_{t=0}^{4} \Delta y_{t-\ell}$</td>
<td>$\sum_{t=0}^{4} \Delta p_{t-\ell}$</td>
</tr>
<tr>
<td>(1)</td>
<td>-0.75*** (0.02)</td>
<td>-0.80*** (0.02)</td>
<td>0.25*** (0.03)</td>
<td>0.46*** (0.03)</td>
</tr>
<tr>
<td>(2)</td>
<td>Cash$_{i,t-1}$</td>
<td>-0.19*** (0.05)</td>
<td>-0.09* (0.05)</td>
<td>-0.19*** (0.05)</td>
</tr>
<tr>
<td>(3)</td>
<td>$\sum_{t=0}^{4} \text{Cash}<em>{i,t-1} \cdot \Delta ff</em>{t-\ell}$</td>
<td>0.06*** (0.02)</td>
<td>0.15*** (0.02)</td>
<td>-0.16*** (0.03)</td>
</tr>
<tr>
<td>(4)</td>
<td>$\sum_{t=0}^{4} \text{Cash}<em>{i,t-1} \cdot \Delta y</em>{t-\ell}$</td>
<td>0.00 (0.01)</td>
<td>-0.02*** (0.01)</td>
<td>0.01** (0.01)</td>
</tr>
<tr>
<td>(5)</td>
<td>$\sum_{t=0}^{4} \text{Cash}<em>{i,t-1} \cdot \Delta p</em>{t-\ell}$</td>
<td>0.08*** (0.01)</td>
<td>0.11*** (0.01)</td>
<td>0.07*** (0.01)</td>
</tr>
<tr>
<td>(6)</td>
<td>$\sum_{t=0}^{4} \text{Cash}<em>{i,t-1} \cdot \text{RegQ}</em>{t-\ell}$</td>
<td>-0.22*** (0.02)</td>
<td>-0.17*** (0.02)</td>
<td></td>
</tr>
<tr>
<td>(7)</td>
<td>$\sum_{t=0}^{4} \text{Cash}<em>{i,t-1} \cdot \text{RegQ}</em>{t-\ell} \cdot \Delta ff_{t-\ell}$</td>
<td>0.17*** (0.01)</td>
<td>0.17*** (0.02)</td>
<td></td>
</tr>
<tr>
<td>(8)</td>
<td>$\sum_{t=0}^{4} \text{Cash}<em>{i,t-1} \cdot \Delta ff</em>{t-\ell} + \sum_{t=0}^{4} \text{Cash}<em>{i,t-1} \cdot \text{RegQ}</em>{t-\ell} \cdot \Delta ff_{t-\ell}$</td>
<td>0.01 (0.02)</td>
<td>0.06*** (0.02)</td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.83</td>
<td>0.83</td>
<td>0.83</td>
<td>0.83</td>
</tr>
<tr>
<td>Observations</td>
<td>1,159,253</td>
<td>1,160,365</td>
<td>1,160,123</td>
<td>1,160,686</td>
</tr>
</tbody>
</table>

Robust standard errors after clustering at bank level in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
## Results – Securities Holdings

$\Delta L_{i,t}$

<table>
<thead>
<tr>
<th>Model</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sum_{t=0}^{4} \Delta ff_{t-\ell}$</td>
<td>-0.75***</td>
<td>-0.80***</td>
<td>0.25***</td>
<td>0.46***</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Securities$_{i,t-1}$</td>
<td>-0.74***</td>
<td>-0.61***</td>
<td>-0.76***</td>
<td>-0.60***</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>$\sum_{t=0}^{4}$ Securities$<em>{i,t-1} \cdot \Delta ff</em>{t-\ell}$</td>
<td>-0.15***</td>
<td>-0.22***</td>
<td>0.14***</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>$\sum_{t=0}^{4}$ Securities$<em>{i,t-1} \cdot \Delta y</em>{t-\ell}$</td>
<td>0.16***</td>
<td>0.14***</td>
<td>0.15***</td>
<td>0.12***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>$\sum_{t=0}^{4}$ Securities$<em>{i,t-1} \cdot \Delta p</em>{t-\ell}$</td>
<td>0.16***</td>
<td>0.15***</td>
<td>0.17***</td>
<td>0.17***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>$\sum_{t=0}^{4}$ Securities$<em>{i,t-1} \cdot \operatorname{RegQ}</em>{t-\ell}$</td>
<td>-0.01</td>
<td>-0.07***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sum_{t=0}^{4}$ Securities$<em>{i,t-1} \cdot \operatorname{RegQ}</em>{t-\ell} \cdot \Delta ff_{t-\ell}$</td>
<td>-0.21***</td>
<td>-0.15***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sum_{t=0}^{4}$ Securities$<em>{i,t-1} \cdot \Delta ff</em>{t-\ell} +$ Securities$<em>{i,t-1} \cdot \operatorname{RegQ}</em>{t-\ell} \cdot \Delta ff_{t-\ell}$</td>
<td>-0.06***</td>
<td>-0.16***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| $R^2$ | 0.83 | 0.83 | 0.83 | 0.83 |
| Observations | 1,159,253 | 1,160,365 | 1,160,123 | 1,160,686 |

Robust standard errors after clustering at bank level in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Changing Loan Demand Elasticities

Changes in loan demand elasticities support, rather than harm, the argument about Regulation Q as an identified loan supply shifter:

![Diagram showing structural changes in loan demand interest rate elasticities](image_url)

**Figure:** Structural Changes in Loan Demand Interest Rate Elasticities
Great Moderation?

Stock and Watson (2002), p. 161

“Both univariate and multivariate estimates of the break date center on 1984. When we analyze 168 series for breaks in their conditional variance, approximately 40 percent have significant breaks in their conditional variance in 1983 to 1985. Our 67 percent confidence interval for the break date in the conditional variance of four-quarter GDP growth (given past values of GDP growth) is 1982:4 to 1985:3, consistent with Kim and Nelson’s (1999) and McConnell and Perez-Quiros’s (2000) estimate of 1984:1.”
Main Findings and Future Avenues

Main results

- Deposit ceilings ideal for identifying bank credit supply shifts
- The more binding Regulation Q, the less was mean lending
- Qualitative difference in policy transmission via credit
- Quantitative difference vis-a-vis constrained estimate by a factor of up to 10

Future directions

- Integrating work in monetary policy identification and the lending channel (see Bowdler, Bluedorn, and Koch, 2015)
F. Freixas and C. Rochet.
*Microeconomics of Banking.*

H. Degryse, M. Kim, and S. Ongena.
*Microeconometrics of Banking: Methods, Applications, and Results.*

A. Ashcraft.
New Evidence on the Lending Channel.

B. Bernanke and A. Blinder.
The Federal Funds Rate and the Channels of Monetary Transmission.

J. Bluedorn, C. Bowdler and C. Koch.

N. Cetorelli and L. Goldberg.
Banking Globalization, Monetary Transmission and the Lending Channel.
References II

J. Duca.
Assessing Monetary Policy and Deposit Deregulation. 

J. Duca.
The Interest Sensitivity of GDP and Accurate Reg Q Measures. 

A. Kashyap and J. Stein.
What Do a Million Observations on Banks Say About the Transmission of Monetary Policy? 

R. Kishan and T. Opiela.
Bank Size, Bank Capital, and the Bank Lending Channel. 

E. Loutskina and P. Strahan.

K. Mertens.
Deposit Rate Ceilings and Monetary Transmission in the U.S. 
Review: Channels of Monetary Transmission

Six channels of transmission of policy changes to aggregate demand

1. Interest rate channel
2. Exchange rate channel
3. Wealth channel
4. Balance sheets channel
5. Bank lending channel
6. Portfolio balance channel

See McCarthy (2012, FRB NY)
“*The Federal Reserve in the 21st Century The Monetary Transmission Mechanism*”
Review: Channels of Monetary Transmission

- Open Market Operation
  - Reserves
    - Fed Funds Rate (FFR)
    - Fed asset holdings
Review: Channels of Monetary Transmission

- Open Market Operation
  - Reserves
    - Fed Funds Rate (FFR)
    - Fed asset holdings

Aggregate demand

- Real GDP, Employment
- Inflation
Review: Channels of Monetary Transmission

Open Market Operation

Reserves

Fed Funds Rate (FFR)  Fed asset holdings

Aggregate demand

Real GDP, Employment  Inflation
Review: Channels of Monetary Transmission

- Open Market Operation
  - Reserves
    - Federal Funds Rate (FFR)
    - Fed asset holdings
Review: Channels of Monetary Transmission

Open Market Operation

- Reserves
- Expected path of FFR
- Expected path of Fed asset holdings
- Expected path of short-term nominal interest rates
- Expected path of Fed asset holdings
- Long-term real interest rates
- Aggregate demand

Policy communication and commitment

Expectations of future inflation

Policy communication and commitment
Review: Channels of Monetary Transmission

- Open Market Operation
- Reserves
- Expected path of FFR
- Expected path of Fed asset holdings
- Expected path of short-term nominal interest rates
- Exchange rate
- Aggregate demand

Policy communication and commitment

Expectations of future exchange rates
Review: Channels of Monetary Transmission

- Open Market Operation
- Reserves
  - Expected path of FFR
  - Expected path of Fed asset holdings
    - Expected path of short-term nominal interest rates
      - Asset price levels
        - Aggregate demand

Policy communication and commitment
Expectations of future inflation
Review: Channels of Monetary Transmission

- Open Market Operation
  - Reserves
    - Expected path of FFR
    - Expected path of Fed asset holdings
    - Expected path of short-term nominal interest rates
  - Asset price levels
    - Collateral
  - Aggregate demand

- Policy communication and commitment
- Expectations of future inflation
Review: Channels of Monetary Transmission
Review: Channels of Monetary Transmission

Open Market Operation

Reserves

Expected path of FFR

Expected path of Fed asset holdings

Expected path of short-term nominal interest rates

Aggregate demand

Policy communication and commitment

Portfolio balance effect

Relative asset prices
Review: Channels of Monetary Transmission

- Open Market Operation
- Reserves
- Expected path of FFR
- Expected path of short-term nominal interest rates
- Expected path of Fed asset holdings
- Loan supply
- Asset price levels
- Collateral
- Long-term real interest rates
- Exchange rate
- Relative asset prices
- Aggregate demand
- Bank lending channel
- Balance sheets channel
- Wealth channel
- Interest rate channel
- Exchange rate channel
- Portfolio balance channel
- Policy communication and commitment
- Expectations of inflation
- Expectations of inflation and exchange rates
# Consolidated Report of Condition for Insured Banks and Savings Associations for September 30, 2013

All schedules are to be reported in thousands of dollars. Unless otherwise indicated, report the amount outstanding as of the last business day of the quarter.

## Schedule RC—Balance Sheet

<table>
<thead>
<tr>
<th>Assets</th>
<th>Dollar Amounts in Thousands</th>
<th>RCFD</th>
<th>Tril</th>
<th>Bil</th>
<th>Mil</th>
<th>Thou</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cash and balances due from depository institutions (from Schedule RC-A):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Noninterest-bearing balances and currency and coin</td>
<td>0081</td>
<td>0071</td>
<td>1.a.</td>
<td></td>
<td></td>
<td>1.b.</td>
</tr>
<tr>
<td>b. Interest-bearing balances</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Securities:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Held-to-maturity securities (from Schedule RC-B, column A)</td>
<td>1754</td>
<td>1772</td>
<td>2.a.</td>
<td></td>
<td></td>
<td>2.b.</td>
</tr>
<tr>
<td>b. Available-for-sale securities (from Schedule RC-B, column D)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Federal funds sold and securities purchased under agreements to resell:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Securities purchased under agreements to resell</td>
<td>RCFD B989</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.b.</td>
</tr>
<tr>
<td>4. Loans and lease financing receivables (from Schedule RC-C):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Loans and leases held for sale</td>
<td>5369</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.a.</td>
</tr>
<tr>
<td>b. Loans and leases, net of unearned income</td>
<td>B528</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.b.</td>
</tr>
<tr>
<td>c. LESS: Allowance for loan and lease losses</td>
<td>3123</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.c.</td>
</tr>
<tr>
<td>d. Loans and leases, net of unearned income and allowance (item 4.b minus 4.c)</td>
<td>B529</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.d.</td>
</tr>
<tr>
<td>5. Trading assets (from Schedule RC-D)</td>
<td>3545</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.</td>
</tr>
<tr>
<td>6. Premises and fixed assets (including capitalized leases)</td>
<td>2145</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.</td>
</tr>
<tr>
<td>7. Other real estate owned (from Schedule RC-M)</td>
<td>2150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.</td>
</tr>
<tr>
<td>8. Investments in unconsolidated subsidiaries and associated companies</td>
<td>2130</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.</td>
</tr>
<tr>
<td>10. Intangible assets:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.a.</td>
</tr>
<tr>
<td>b. Other intangible assets (from Schedule RC-M)</td>
<td>0426</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.b.</td>
</tr>
<tr>
<td>11. Other assets (from Schedule RC-F)</td>
<td>2160</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.</td>
</tr>
<tr>
<td>12. Total assets (sum of items 1 through 11)</td>
<td>2170</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.</td>
</tr>
</tbody>
</table>
Reporting Forms: Now and Then
NOTES: Grey bars indicate recessions. Maximum number of report pages for domestic banks only.
2001:Q1-present: Form FFIEC 041.
DATA SOURCES: Call Reports, Federal Financial Institutions Examination Council; Federal Reserve Bank of Dallas.
Reporting Forms: Now and Then

Number of Reported Entries in Call Reports

Note: * Q4 of Each Year.
Sources: FFIEC CALL Reports, Federal Reserve Bank of Dallas.